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TABLE OF CONTENTS

Studies on the Habits and Distribution of *Cryptocerus texanus* Santschi (Hymenoptera: Formicidae). *W. S. Creighton* and *R. E. Gregg* . 41

Transporting Live Hippoboscids (Diptera). *I. B. Tarshis* 58

A Large Bombus Nest from Mexico. *C. D. Michener* and *W. E. LaBerge* 63

New Synonymy of an Australian Iridomyrmex (Hymenoptera: Formicidae). *W. L. Brown, Jr.* 67

The Indo-Australian Species of the Ant Genus *Strumigenys* Fr. Smith: *S. chapmani* New Species. *W. L. Brown, Jr.* 68

Tabanidae of New Hampshire. *R. L. Blickle* 74

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PSYCHE

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STUDIES ON THE HABITS AND DISTRIBUTION OF *CRYPTOCERUS TEXANUS* SANTSCHI (HYMENOPTERA: FORMICIDAE)

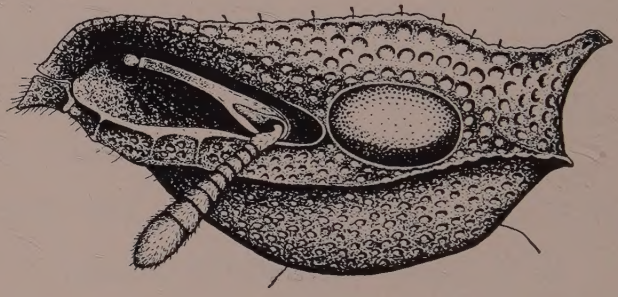
By W. S. Creighton, City College, New York
and
R. E. Gregg, University of Colorado

In recent years Dr. M. R. Smith (1,2) and Fr. W. W. Kempf (3,4) have published papers on the genus *Cryptocerus*[1]. These studies deal primarily with taxonomy and do not supply many data on the habits of the ants of this genus. The habits of *Cryptocerus texanus*, the only member of the group whose occurrence in the United States can be regarded as abundant, thus remain largely unknown. From the fall of 1951 to the spring of 1953 the senior author took twenty colonies of *C. texanus* in southern Texas and northeastern Mexico[2]. Three of these colonies were studied in artificial nests for several weeks and later three more colonies were sent to the junior author for further observation. One of this second group of colonies was still alive a year afterwards when this paper was sent to press. The habits recorded here were largely determined from studies made on these six colonies.

[1]The writers have appealed to the International Commission on Zoölogical Nomenclature to have Emery's use of the generic names *Cephalotes* and *Cryptocerus* sustained. Until a decision has been handed down we prefer to use Emery's system. The name changes advocated by Dr. Smith have already caused regrettable confusion in this group.

[2]Fieldwork done on a Guggenheim Fellowship.

Before discussing these studies it seems advisable to present certain general observations on *Cryptocerus texanus*. In the paper which Dr. M. R. Smith published on *texanus* in 1947(1) seventeen stations were listed. Only six of these carried notations as to the nest site of the



a.

b.

Figure 1. *Cryptocerus texanus*: a, lateral view of the head of the major; b, sculpture of the cephalic disc on the head of the major, showing the rectangular, silvery, longitudinally grooved hair in each foveola. Figure 1, a, is drawn to a scale twice that of plates 3 and 4.

colony. Of these six only one referred to a nest in a live-oak tree. On the basis of the above data it would be unlikely for anyone to conclude that *texanus* prefers to nest in live-oaks. Nevertheless, this appears to be the case. Presented below is a list of trees in which *texanus* has been found nesting. This is a composite of the data published by Dr. Smith and those more recently secured by the senior author. In two cases the information reported by Dr. Smith

has been interpreted on the basis of probability so that it fits into the list. Thus his nest reported from "persimmon" has been assigned to *Brayodendron* and that said to have come from a "live-oak" has been allocated to *Q. virginiana.*

1. *Quercus virginiana* (live-oak) 14 colonies
2. *Quercus fusiformis* (live-oak) 3 colonies
3. *Quercus stellata* (deciduous oak) 2 colonies
4. *Zygia flexicaulis* (Texas ebony) 3 colonies
5. *Brayodendron texanum* (Mexican persimmon) 2 colonies
6. *Xanthoxylum clava-herculis* (prickly ash) 1 colony
7. *Celtis pallida* (hackberry) 1 colony
8. *Prosopis juliflora* (mesquite) 1 colony

Of the twenty-seven colonies listed above seventeen (63%) came from live-oaks. It thus appears that *texanus* definitely prefers to nest in live-oaks, although it is sufficiently flexible in its nesting habits to accept other trees as well.

The size of the colony and the number of deälated queens present are also matters of interest. Four of the colonies taken by the senior author were plainly fragmentary and these have been omitted from the list below.

	Female	Major	Media & Minor	Total	Station
1.	1	8	22	31	Lapara Creek, Texas
2.	6	10	73	89	" " "
3.	1	19	56	76	" " "
4.	3	12	52	69	" " "
5.	5	25	61	91	Hochheim, Texas
6.	2	13	37	52	" "
7.	2	6	53	61	Floresville, Texas
8.	1	17	53	71	Gambel Creek, Texas
9.	22	13	115	150	Sealy, Texas
10.	5	18	55	78	Iturbide Canyon, Nuevo Leon
11.	3	8	25	36	" " " "
12.	0	46	186	232	" " " "
13.	0	9	28	37	" " " "
14.	1	8	31	40	El Pastor, Nuevo Leon
15.	7	10	32	49	Belmont, Texas
16.	2	1	26	29	" "

Two facts are shown by the above figures. The colonies of *texanus* are always small and they are often pleometrotic. It may be stated that most of the above colonies came from separate trees. The chance that a colony of *texanus* may be polydomus was constantly kept in mind. Hence colonies taken in closely adjacent limbs or at separated intervals in the same limb were treated as parts of a single nest. It may be, therefore, that the relatively large totals in colonies 9 and 12 represent more than a single colony.

The outstanding point of interest in the biology of *texanus* is the possibility that the major may serve in a phragmotic capacity. A good deal of what has been said on this subject seems to have been published without much idea of certain structural features which are involved. In order to make these features clear the junior author has prepared figures of the female, major and minor of *Cryptocerus texanus* (Pls. 3 and 4; text-figs. 1 and 2). Reference to these figures will show that the prominent cephalic disc present in the female and major of *texanus*, does not cover all of the upper surface of the head. Projecting rearward beyond this disc are two conspicuous occipital angles. Although these angles lie below the level of the rim of the disc they cannot be disregarded for they, and not the rounded posterior rim of the cephalic disc, determine the size of the aperture into which the head can be thrust. Behind these occipital angles stand the even more prominent humeral angles of the thorax. In the figure of the major considerations of perspective have made it necessary to show these angles as wider than the head, for the latter lies below and in front of them. But, even disregarding the matter of perspective, the maximum width of the dorsum of the thorax at the humeral angles equals or slightly exceeds the maximum diameter of the cephalic disc. It follows that the thorax of the major and the female of *texanus* (at least at the humeri) is fully as wide as the head and often a little wider than the head. It further follows that the diameter of a passage which the *texanus* major can occlude is determined as much by the width of the prothorax as it is by the size and shape of the cephalic disc. The failure of previous investigators to grasp this fact has been the cause of confusion in the past.

The first person to suggest a phragmotic function for the major of *Cryptocerus* appears to have been W. M. Wheeler. In 1905 (5) Wheeler stated that the nest entrance of several colonies of *Cryptocerus varians,* which he had found in hollow twigs in the Bahamas, was always exactly the size and shape of the cephalic disc of the major. Wheeler made no claim that the major blocks the nest entrance with its head, but the implication that it does so was clear and this seems to have been the basis for later views expressed by Wheeler in 1910 (6) and by Emery in 1922 (7) that the major of *Cryptocerus* is probably phragmotic. But no

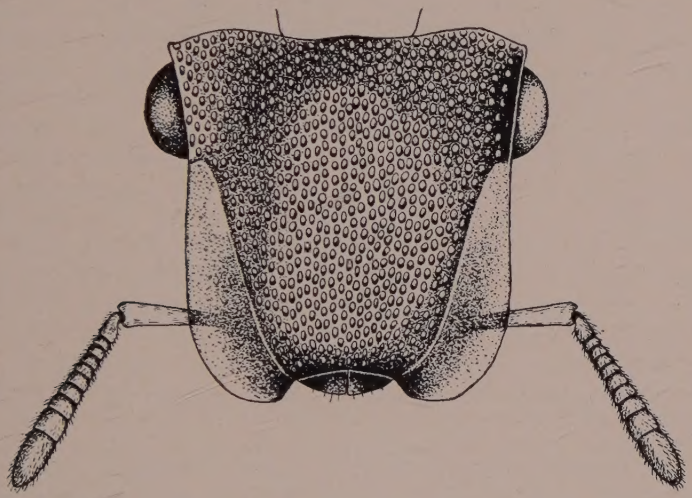


Figure 2. Dorsal view of the head of the minor of *Cryptocerus texanus.* Drawn to the same scale as figure 1, a.

positive statement was made on this point until 1942. In that year a posthumous paper by Wheeler (8) which had been prepared for publication by Dr. Joseph Bequaert, definitely made such a claim in the case of *Cryptocerus pallens* (the variety *porrasi*) and *C. setulifer.* The statement concerning *pallens* is as follows:

"Its habits are similar to those of *Colobopsis.* The elliptical nest entrance is guarded by one of the soldiers which occludes the orifice with its disc-shaped cephalic disc just as the *Colobopsis* soldier uses the truncated anterior sur-

face of the head for the same purpose. The cephalic disc in old soldiers and in the mother queen of the colony often becomes coated with dirt and extraneous particles so that it closely resembles the bark of the plant."

The most recent note on the phragmosis of *Cryptocerus* is that which Kempf published in 1952 (4). Kempf's single observation on *Cryptocerus maculatus* failed to show the behavior cited by Wheeler. It was not until Kempf had enlarged the small nest entrance that any majors were seen. These majors, which were well inside the nest, then tried to occlude the passage which Kempf had opened up by standing "side on side". Kempf recalled that a similar compound shield, consisting of the approximated heads of several minor workers, was reported for a colony of *Cephalotes atratus* by Santschi in 1919 (9). The date of this publication is incorrectly given by Kempf as 1929. Kempf was clearly aware that neither Santschi's observation on *atratus* nor his own on *maculatus* are comparable to Wheeler's statement of the phragmosis of the major of *pallens*. But the writers agree with Kempf that clarification is needed in the case of Wheeler's 1942 statement. The major of *Cryptocerus* is undoubtedly phragmotic, but it is misleading to say that it behaves just as does the *Colobopsis* major. The notable differences which mark the reaction of the *Cryptocerus* major are discussed in the following pages.

The junior author's colonies were housed in the modified Janet nests used in earlier studies on *Pheidole* (10). These nests gave little opportunity for studying the phragmosis of *texanus*, since they lacked restricting passages. In order to study this response two other types of nests were used, both of very simple construction. The first consisted of two glass vials with the bottoms removed. These vials were held together by a cork, which was forced into the neck of each vial until the two rims touched. On one side of this cork a groove was cut which approximated the size and shape of the cephalic disc of the major as closely as possible. The open end of each vial was plugged with cotton after the colony was installed. The second type of nest was a small, plaster one, cast over a microscope slide.

After the plaster hardened the slide was removed and suitable chambers and passages were cut in the plaster. The slide was then put back in place and held in position with rubber bands. In both these nests the action of the major in the passages could be easily observed and the passages could be enlarged when necessary.

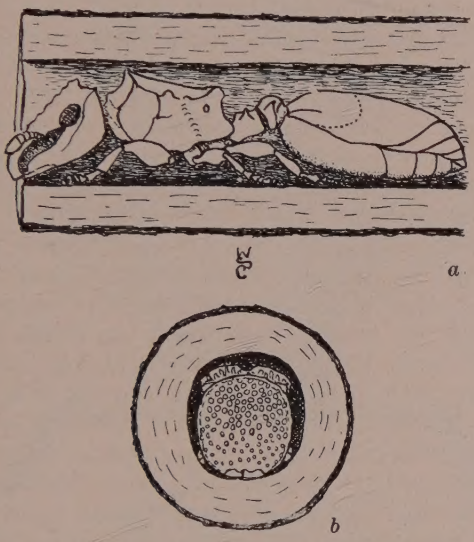


Figure 3. a, lateral view of the major of *Cryptocerus texanus* in the phragmotic position in a hollow twig; b, cephalic disc of above major seen in full-face view.

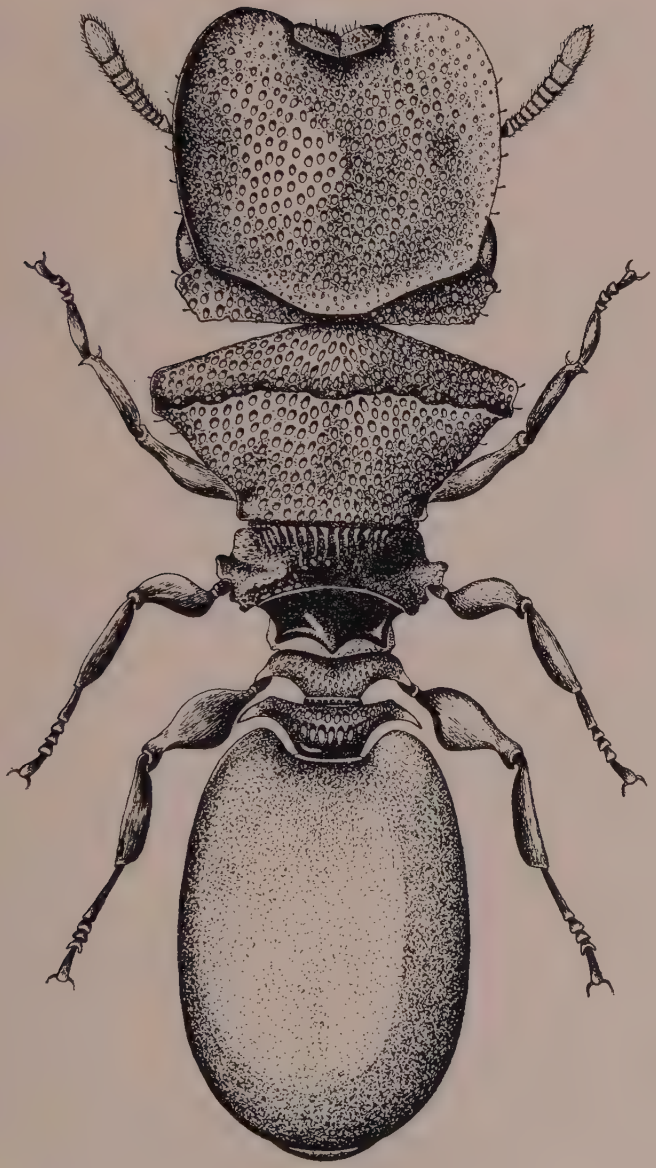
It soon became apparent that if the passages were made to fit the cephalic disc of the major closely, this caste would not enter them at all. Since the medias and minors would use such passages freely there was no reason to suppose that anything other than the size of the passage determined the refusal of the majors to use them. When such passages were enlarged the majors used them without hesitation. But this behavior indicated that the major of *texanus* cannot or will not go into a passage whose size and shape closely approximates that of the cephalic disc. The reason for this appears to lie in the fact that the major of *texanus* occludes the nest opening not only with the cephalic disc

but with the humeri of the thorax as well. The head of the major of *texanus* can be lowered until its long axis is at right angles to the long axis of the rest of the body. Although many majors die in this position it is rarely assumed by the living insect, presumably because in such a posture the anterior edge of the head is so far below the level of the coxae that the insect would have to stand on tiptoe to keep the mandibles clear of the substrate. Conversely, the head of the major can be raised until its long axis is parallel to that of the rest of the body. Under such circumstances the rim of the cephalic disc lies at the same level as the dorsum of the thorax. But in this position the head of the major does not occlude the passage for there is then a considerable space below the ventral surface of the head. To occlude the passage the major must lower the head until its anterior edge is on or near the floor of the passage. But when the head of the major is in this position, with its long axis forming an angle of approximately 120° with the long axis of the rest of the body, the posterior rim of the cephalic disc is well below the level of the humeral angles. Thus if a major of *texanus* is to occlude a passage, this passage must be large enough to accommodate not only the cephalic disc but also the humeral angles above and behind it. For if the head is lowered enough to form an effective barrier there is no way in which the humeral angles can be brought down to the level of the posterior rim of the cephalic disc. It would appear, therefore, that it is physically impossible for the major of *texanus* to occlude a passage whose size closely approximates that of the cephalic disc.

It may be readily appreciated that the situation just described is wholly different from that which marks the major of *Colobopsis*. In the cork-shaped head of the major of *Colobopsis* maximum occlusion occurs when the long axis of the head is parallel to that of the rest of the body. In this position the truncated anterior face of the head is presented to the exterior. Since the diameter of this truncated portion exceeds that of any other part of the

EXPLANATION OF PLATE 3

Cryptocerus texanus, dorsal view of the major.



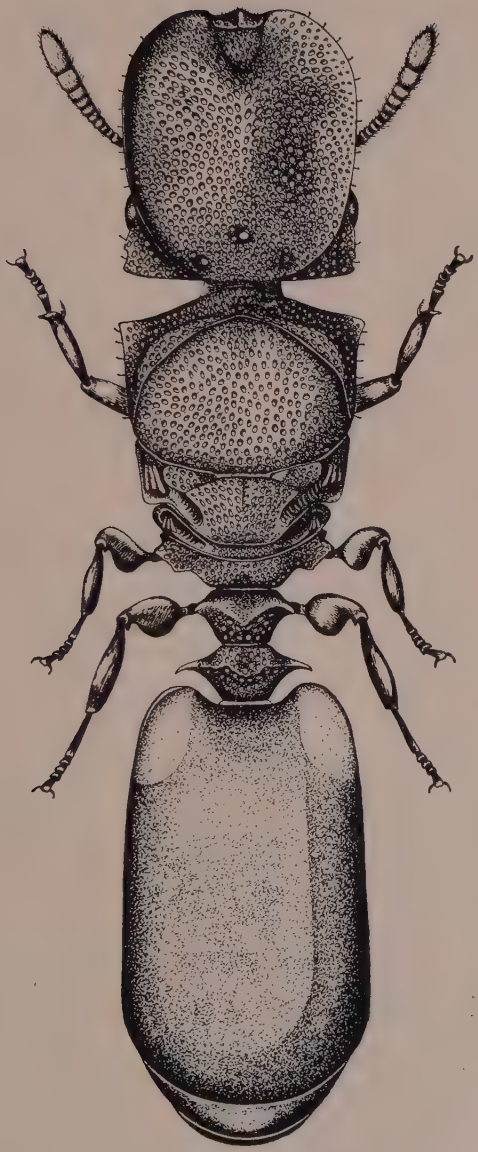
CREIGHTON AND GREGG — CRYPTOCERUS TEXANUS

insect, it follows that the head of the *Colobopsis* major can be thrust into close-fitting apertures without putting the rest of the insect into an impossible posture.

We may now consider the method by which minors of *texanus* are admitted to the nest. When the guarding major has assumed the phragmotic position the lower rim of the head usually projects slightly beyond the edge of the nest entrance. The antennae are held at either side of the cephalic disc and are clearly visible from the outside. The returning minor may or may not touch the antennae of the guard, although it usually does so. Thereafter the guard crouches down. This brings the anterior rim of the head below the level of the floor of the passage or, if the guard stands completely inside the passage, the front of the head is raised as the guard crouches. The dorsum of the guard's thorax is now no longer close to the roof of the passage and the minor can, if it is sufficiently active, wriggle between the dorsum of the thorax and the roof of the passage. This action is seldom completed without considerable struggle on the part of the entering minor and at times the major will cease to crouch before the minor has gone through and pin the minor between its thoracic dorsum and the roof of the passage. The senior author has seen minors thus trapped who, perforce, remained in this awkward position for several minutes until the major would crouch again and release them. If the passageways are made large enough to accomodate two majors simultaneously, they ordinarily assume a position where they are back to back. Under such circumstances the two opposed cephalic discs form a V-shaped area. The bottom of this V is open but the space behind it is closed by the closely approximated thoracic dorsi of the two guards. When minors are admitted to the nest both majors crouch and the entering worker struggles through the narrow space between the thoraces of the guards. It seems scarcely necessary to state that there is no part of this behavior which at all resembles that of the *Colobopsis* major, which must back away from the nest entrance to admit the returning minor.

Explanation of Plate 4

Cryptocerus texanus, dorsal view of deälated female.



Creighton and Gregg — Cryptocerus texanus

Two other habits of the major of *texanus* may be mentioned. It should be apparent that when a major is in a closely confining passage its head has much the position of the blade of a snowplow. The concave surface of the cephalic disc slopes forward and downward and its lower rim is close to the floor of the passage. When a major moves forward along a passage any minors which are in it are pushed ahead of the advancing major unless they are active enough to force their way between the thoracic dorsum of the major and the roof of the passage. This sometimes leads to rather surprising results for workers clustered within the nest entrance may be suddenly ejected from the nest by the advancing major. Before assuming its phragmotic position the major often comes out of the nest entirely. After exploring the area immediately around the entrance it backs into the passage. This is never true of minors who always go through the nest entrance head first.

Much remains to be learned about the feeding habits of *texanus*. In 1947 M. R. Smith published the statement that our species of *Cryptocerus* feed "largely on honey dew or the flesh of small arthropods"(2). This may be true but the writers were unable to discover any food for which the captive colonies showed much relish. They refused mealworms and termites, even when the latter were torn open to expose the tissues. High protein foods such as peanut butter and cheese were also refused. This would seem to indicate a distaste for a protein diet but other observations contradict such a view. While the ants refused pure honey they accepted honey mixed with egg yolk. In one instance an injured female was accidentally included when a colony was installed in an artificial nest. The gaster of this female had been broken open and her own workers promptly proceeded to eviscerate her. The gastric contents were completely cleaned out in a few hours. This action may have been due to some improper condition in the artificial nest and the food in this case can scarcely be the regular dietary staple of the insects. Yet it can be stated that was the only instance where the workers seemed at all interested in what they were eating. Other foods which were refused were pears, apples and

jelly. Bananas were accepted by some colonies but rejected by others. The most generally acceptable food seemed to be maple syrup. This suggests that the insects may possibly feed on the sap of the trees in which they live. If this is the case it is probable that such a diet is augmented by other food, for the workers of *texanus* forage on the surface of the ground, which they would scarcely do if the diet was entirely confined to sap. Whatever the natural food of *texanus* may be it seems certain that it is not sticky. Both writers found that it was inadvisable to leave sticky food in the nest for any length of time, since a number of minors were certain to get caught in it. The other workers make no effort to free their trapped nestmates, who ultimately die.

To judge from the captive colonies these ants are very sluggish in their nests. They often pack themselves together in a nest chamber or passage and remain immobile for hours. If disturbed both majors and minors may open their mandibles and keep them open. This is a preliminary to an attack on any intruder. When living termites were placed in the captive nests they were immediately attacked by both majors and minors. The attack was made with the open jaws of the attackers held close to the floor of the nest. As a result the termites suffered very little damage to any parts except their legs. These were rapidly cut off, but once the termites had been immobilized no further attention was paid to them.

The female of *texanus* lays a comparatively large egg and has considerable difficulty in doing so. The egg, which is from 1.3 to 1.5 mm. in length and about 0.5 mm. in diameter, is cylindrical with rounded ends. The senior author twice observed the process of egg-laying in this species. In both cases the egg was about one-quarter of its length out of the end of the gaster when first observed. Its extrusion was not a continuous process but proceeded by a series of slight motions which occurred at intervals. The entire process consumed about ten minutes. On one occasion the partially extruded egg was seized by a worker who pulled on it with sufficient force to haul the female backward without, however, releasing the egg from the gaster. Since only two instances of egg-laying were ob-

served the writers are not sure that the process described above is normal for *texanus*. But it should be remembered that the gaster of the *texanus* female is heavily sclerotized and because of this a large egg should be difficult to eject. Brood is tended by both minors and majors who, despite their clumsy heads, handle the eggs and young larvae with surprising gentleness.

The distribution of *texanus* is unusually interesting, since it is one of the few cephalotine ants which live outside the tropics. The structural relationship of *texanus* to certain Neotropical species is close but, because of the lack of records from northeastern Mexico, the spatial relation of *texanus* to the more southern species has been conjectural. In the following pages the writers have discussed the distribution of *texanus* and that of several other cephalotines which occur in eastern Mexico. The northern range of the latter species seldom agrees with the data published by Kempf in 1951 (3) and 1952 (4). In his important work with the cephalotine ants Kempf has been hampered by lack of adequate records from Mexico. This is particularly true of the region north of Mexico City, where the ranges of several Neotropical species terminate. Kempf cannot be blamed for the absence of records from this area but his attempt to supply distribution data from specimens intercepted at plant quarantine stations is far from satisfactory. Kempf's citation of Guerrero, Coahuila as a possible source of specimens of *C. minutus*, intercepted on orchids and labelled only "Guerrero" is a case in point. Guerrero, Coahuila lies four hundred miles outside the northern limit of the range of *C. minutus*. Moreover, the village is situated in a very arid part of the Rio Grande Valley where the ants are strictly xerophilous. That *minutus* could occur there is out of the question.

Most of the colonies of *texanus* secured by the senior author came from the area outlined by M. R. Smith in his 1947 publication. They were taken in what may be called the Brownsville-San Antonio-Houston triangle. The record from Sealy extends the known range of *texanus* about twenty-five miles to the east of its former limit (Columbus, Texas) but this extension is negligible and we agree with Dr. Smith that it is unlikely that *texanus* occurs east

of Texas. On the other hand the records from Nuevo Leon are a significant southern extension of the range. It may be recalled that Dr. Smith had specimens of *texanus* which came from Mexico but the source of these specimens was unknown. It is now clear that *texanus* occurs in the foothills of the Sierra Madre Oriental at least as far south as the latitude of Linares (24° 40′). Of the five colonies taken in Nuevo Leon, one came from El Pastor, a small village west of Montemorelos, and the remaining four from Iturbide Canyon, west of Linares. In this area the ant nests at elevations about the 2300 foot level, a considerable elevational rise over the stations in southern Texas, none of which were more than a few hundred feet above sea-level.

In addition to *texanus* the following cephalotine ants were taken in eastern Mexico:

Procryptocerus scabriusculus Em.
Cryptocerus scutellatus Sm.
Cryptocerus cristatus Em.[1]
C. (*Paracryptocerus*) *minutus* Em.

Because of the lack of reliable records from eastern Mexico a list of the localities where these species were taken is presented here:

San Luis Potosi:

Tamazunchale (600-800′) five colonies of *C.* (*Paracryptocerus*) *minutus;* one colony of *C. scutellatus;* Xilitla Ferry (200′) 22 miles north of Tamazunchale, one colony of C. (*Paracryptocerus*) *minutus;* Xilitla (1800′) one colony of *C.* (*Paracryptocerus*) *minutus,* one colony of *Procryptocerus scabriusculus;* 3 miles east of Xilitla (2000′) one colony of *Cryptocerus cristatus;* Axtla (200′) 23 miles northeast of Tamazunchale, one colony of *Cryptocerus scutellatus*[2]*;* 22 miles east of Ciudad del

[1]The single colony of *cristatus* which was taken consisted of eight majors and 330 medias and minors. Kempf believes that majors are seldom produced by *cristatus,* for he found none in the material which he examined. But since this material consisted of only 35 minors and 17 females coming from 11 stations, it seems probable that Kempf's conclusion is the result of inadequate series.

[2]This colony was observed in an artificial nest for a period of three weeks. These observations indicated that the habits of *scutellatus* do not differ significantly from those of *texanus.*

Maiz (3300′) one colony of *Procryptocerus scabriusculus;* El Salto (1400′) 30 miles west of Antiguo Morelos, one stray worker of *Cryptocerus scutellatus.*

TAMAULIPAS:

5 miles west of Altimira (300′) one colony of *C.* (*Paracryptocerus*) *minutus*[1].

The three northernmost records cited above (Ciudad del Maiz, El Salto and Altimira) all lie less than ten miles from Latitude 22° 30′. They are, thus, a little more than fifty miles south of the Tropic of Cancer. As has already been shown the present known range of *texanus* does not extend south of Latitude 24° 40′, which is approximately eighty miles north of the Tropic of Cancer. As things stand at present there is a gap of one hundred and thirty miles between the southern end of the range of *texanus* and the northern end of the range of the species cited above. Further studies in northeastern Mexico, particularly in the mountains southwest of Ciudad Victoria, may narrow or even close this gap. But if this happens it will not alter the fact that the distribution of *texanus* has little in common with that of the Neotropical species. For the range of *minutus* extends to southern Brazil and the other three species range into Colombia and Venezuela. It is safe to assume, therefore, that the area of maximum abundance for each of these species lies well within the tropics. This is certainly not the case with *texanus*, which is more abundant near the latitude of San Antonio, Texas than anywhere else in its range.

A comparable pattern of distribution has been reported by the senior author (11) for another "Neotropical" species, *Pseudomyrmex apache.* It would appear that the Neotropical component of the ant fauna in the southern United States is more complex from a distributional standpoint than has been previously supposed. Some of our representatives are northern fringes of species whose main range lies in the tropics. But others, like *Cryptocerus texanus* and *Pseudomyrmex apache* are more at home out of the tropics than in them. This last type of distribution

[1]Winged males and females were present in this colony and in one from Tamazunchale. Both colonies were taken in early April.

casts considerable doubt on the statement made by Wheeler in 1917 (12) and repeated by Emery in 1920 (13) that the major Neotropical additions to our ant fauna are relatively recent. If this northward migration was, as these authorities suppose, post-Pleistocene (Emery admits the possibility that it may have extended back to the Pliocene) at least there has been time for the development of marked changes in the ecology of some of the migrant species. No other conclusion is possible in the case of *Cryptocerus texanus* and *Pseudomyrmex apache*. The environmental preference of both these species has altered from that of their tropical ancestors to the extent that now neither of them seems capable of life in the tropics. This may, of course, be a recent phenomenon but more likely it indicates a long residence in the areas that they now occupy.

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TRANSPORTING LIVE HIPPOBOSCIDS (DIPTERA)[1]

By I. Barry Tarshis

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During my investigations of the biology of *Stilbometopa impressa* (Bigot) and *Lynchia hirsuta* Ferris, Hippoboscidae of California quail, *Lophortyx calfornica californica* (Shaw and Nodder) (Tarshis, 1953), it was necessary to transport live flies from the field to the laboratory. Three different methods were evolved, which, together with the necessary equipment, are described herewith.

1. *Transporting Live Flies on Quail.* The most satisfactory and the easiest method of transporting live flies from the field to the laboratory after removal of the flies from wild trapped quail (Tarshis, 1952), was the placing of the flies on quail in fly-proof cages. Quail used for transporting flies were brought into the field from the home laboratory as it is a usual requirement that all trapped quail be released in the area from which they are taken, after the flies are removed and all other necessary procedures or observations are completed.

When the flies are to be introduced in the feathers, the bird is placed on its back in the palm of the hand and its left wing is raised (this will be the wing towards the worker's right). The total number of flies to be placed on the bird are slid out of a shell vial into the crotch formed by the bird's wing and body. The wing is then carefully folded back over the flies and held closed so that the flies will not escape. The bird is laid on its back in the cage and the hand very gently removed. If this procedure is meticulously followed the bird will remain motionless for at least

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The author wishes to express sincere appreciation to Dr. M. A. Stewart of the University of California, Dr. J. Bequaert of Harvard University, and Dr. C. M. Herman of the Fish and Wildlife Service for the interest and help extended by them to the author during the course of his investigations.

five to ten minutes. Laying the bird on its back in this manner seems to put it in a state of hypnosis, and meanwhile the flies readily scurry under the feathers.

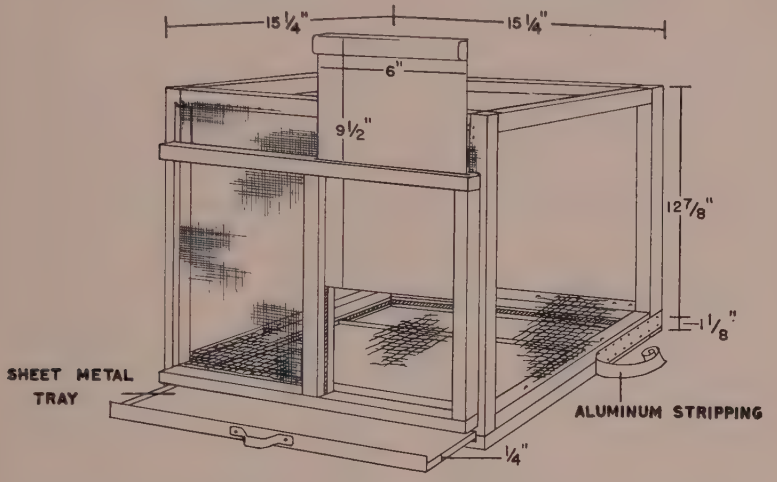

Fig. 1. Fly-proof cage used for transporting quail and live flies from the field to the laboratory.

Only a limited number of flies should be placed on one bird for each trip. One adult quail will tolerate as many as 15 flies of either species of hippoboscid, and a juvenile bird about 10 flies. Birds on which 25 or more flies were placed died of exsanguination.

It was found most desirable to place only one bird carrying flies in each cage. The more birds that are kept in a cage the greater the risk that flies leaving the birds for deposition of prepuparia or for other reasons will be captured or trampled on by the birds. Also, with more than one bird in a cage there is always a great deal of commotion which especially disturbs the gravid female flies, often causing them to deposit their young prematurely. If space is extremely limited two birds may be placed in a single cage, but never more.

The cage shown in Fig. 1 has been found most suitable for transporting live flies on birds. It has an exactly 1 x 1-inch fir stock framework covered on five sides with

No. 16 mesh bronze screen cloth. The bottom of the cage has a ½-inch galvanized hardware cloth floor with a No. 28 gauge galvanized sheet metal collection tray placed on runners 1-inch below this floor. The front of the cage is fitted with a sliding galvanized sheet metal door (No. 28 gauge).

2. *Shipping Live Flies by Mail.* Mailing live flies in cardboard mailing tubes was also tried by the author, but did not prove as successful as the preceding method or the third method described below.

The captured flies were placed in shell vials (24 mm. wide and 95 mm. long) stoppered with perforated, screened corks. These corks were made by removing a large center core from each and then gluing a circle of 1/16-inch mesh nylon bobbinette over the opening on the bottom of the cork. Several of these vials were placed in an 8-inch cardboard mailing tube, cork end up. The metal mailing tube lid was perforated in several places and the underneath surface of the lid was lined with No. 16 mesh bronze screen cloth to prevent loss of flies if a vial broke in transit. The perforated corked vials were next to the perforated mailing tube lid which enabled the flies to get a sufficient amount of air. The bottom of the mailing tube and the spaces between the vials were tightly packed with cotton to prevent rattling or breakage. Where air mail service is available this method is quite adequate, but it is not very satisfactory with ordinary first class or second class postal service. Since hippoboscid flies cannot live long away from the host speed is of prime importance in transporting flies by mail.

3. *Shipping Live Flies in a Cold Temperature Cabinet.* This third method for transporting live hippoboscid flies was found to be very satisfactory. The technique was adapted from one used by Geigy (1948) to ship adult tsetse flies of the species *Glossina palpalis.* Geigy devised and used a cold temperature cabinet, which was adjusted to be kept at 8° C. (46.8° F.), to send adult flies from tropical Africa (Congo) to Basle, Switzerland, via air express.

The present author used the modified cabinet (Fig. 2) to

transport flies by automobile from various field stations to headquarters (distances of 70 to 300 miles). An Arctic Hamper was the basis for the cold temperature cabinet and a wooden stand with a wire basket was placed in the

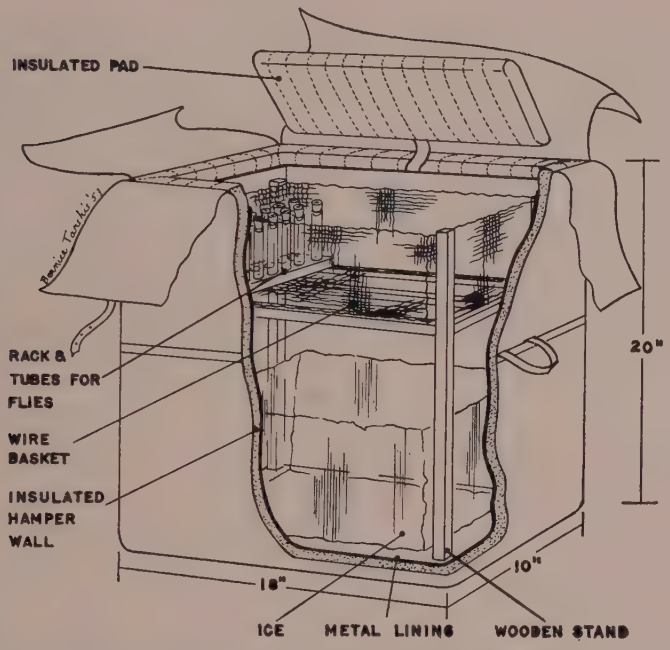

Fig. 2. Cut-away view of Arctic Hamper converted to cold temperature cabinet for transporting live flies from the field to the laboratory.

hamper. A 20-pound piece of ice was placed on the floor of the hamper to keep the temperature around 45° F. Adult flies of both species of quail Hippiboscidae were placed in vials with screened corks (the same vials as used for mailing flies). The vials were placed in racks which fitted into the wire basket in the hamper. The wooden stand was high enough above the ice that the vials did not get wet as the ice melted.

Flies shipped in the cold Arctic Hamper become rigid and motionless but revive quickly after 10 minutes in a

constant temperature cabinet set at 78°F. or when kept at room temperature (70°F.) for a period upwards to 60 minutes.

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A LARGE BOMBUS NEST FROM MEXICO[1]

By C. D. Michener and W. E. LaBerge

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Although many aspects of the bionomics of temperate climate bumblebees are rather well known, little has been published on the biology of tropical species. It therefore seems worthwhile to make known the observations resulting from the excavation of a nest of *Bombus medius* Cresson. The nest was found at the edge of second growth jungle beside a field 15 miles south of Pujal, San Luis Potosi, Mexico, on June 21, 1953. This is in a region shown as tropical evergreen forest in Leopold's (1950) vegetation map of Mexico. It is near the town of Tamazunchale, on which the following climatic data is available: Rainfall average 63.4 inches per year, most of it falling during the months of June to October. Monthly temperature averages range from 63°F. for January to 81°F. for July and August. Minimum temperatures probably reach freezing only once in many years. The bee is a tropical species, ranging from tropical Mexico to Paraguay.

The nest was about four inches below the surface of the ground in a hollow which may have been an old rodent nest. The entrance was a hole about 1.5 inches in diameter. The hollow in which the nest was located was partially filled with decaying strips of bark, leaves, twigs, and the like, on which termites were feeding. The nest itself consisted of an irregular mass of cocoons and cells 10.5 inches in maximum diameter, nearly as large in other diameters, and three to four inches thick. Some of the cocoons were old, their walls whitened with fungus. Some of these old cocoons (about 10%) were filled with honey and sealed. As elsewhere in the nest, no cocoons used for honey storage were elongated with wax before sealing. For the most part these very old cocoons were at one side of the nest and on its lower surface. The bulk of the nest was made up of

[1]Contribution No. 871 from the Department of Entomology, University of Kansas, Lawrence, Kansas.

somewhat younger looking cocoons, most of which were full or partially full of honey, although many had only a little honey in the bottom. Most of the cocoons were arranged in clusters of 7 to 11, each cluster representing a group of young that developed in a single cell. No cocoons large enough to have produced queens were present.

Most pollen pots were made entirely of wax, which like other wax in the nest was soft and black. These pollen pots were up to 18 mm. in diameter and 32 mm. high. Some were empty, others full or partly so. Pollen was also stored in a very few cocoons, and in one or two pollen pots consisting of cocoons lengthened and enlarged with wax.

Cells containing eggs were small, but ranged up to 31 mm. in diameter when the larvae were mature. Several cells contained larvae spinning cocoons and one single larva had pupated.

Remarkably few cocoons contained eggs and larvae, suggesting that reproduction was at a low ebb. This was likely due to the fact that we dug this nest just after the end of the dry season which had been long and intense.

The following is a tabulation of the nest contents:

queen	1
males	0
workers	800
pupae	1
mature larvae	70
medium sized larvae	14
small larvae	18
larvae of unrecorded size	approx. 24
eggs	28
empty cocoons	804
cocoons with honey	1227
large pollen pots with pollen	7
small pollen pots with pollen	16
empty pollen pots	29

From the above tabulation it is evident that the queen must have produced 2183 offspring, of which 2031 had reached maturity before the nest was dug, and of which at least 800 survived until that time. This appears to be

a record for size in bumblebee colonies, especially when it is realized that most large colonies previously recorded contained numerous males.

Nearly all the adult bees were collected. Most of them were in the nest but a great many were afield. We are much indebted to Mr. I. Slesnick for help in capturing the returning bees, about half of which carried pollen. Bees returned at a rather steady rate from the time excavation

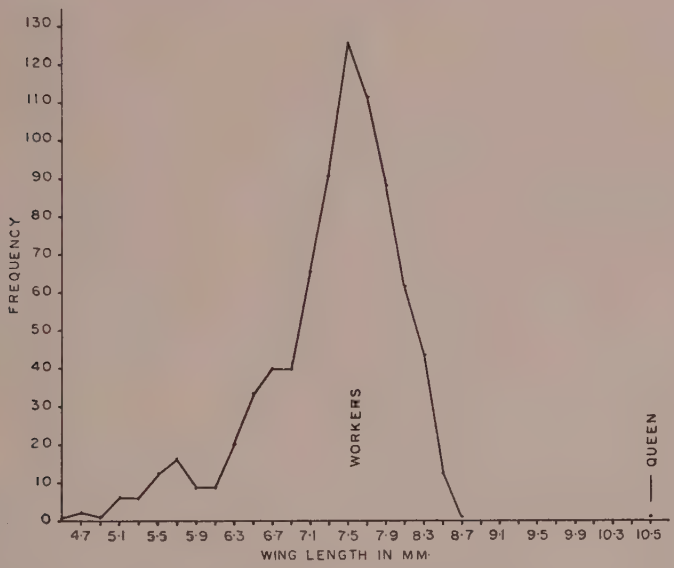

Figure 1. Frequency distribution of the size of the workers and the queen from the nest of *Bombus medius* Cresson based on wing length. The wings were measured from the proximal end of cell 1st M to the distal end of the marginal cell. We wish to thank Mr. Carl W. Rettenmeyer for taking these measurements.

began at 10:00 a.m. until about noon, and at a progressively reduced rate until 1:00 p.m. when the excavation work was complete. No doubt a few returned after this time and were not captured. These data indicate some foraging trips of very long duration.

As shown in figure 1, measurements of the workers show

considerable variation, with a wide discontinuity between the largest worker and the queen. All of the very small workers were found in the nest. Casual observations of foraging bees in this area and elsewhere at lower and middle altitudes in Mexico where this species is common indicate that the smallest workers do not visit the flowers, suggesting that a division of labor among workers has progressed farther than that described by Brian (1952) for *B. agrorum* (Fabricius). She found that while most workers of *agrorum* eventually forage, small ones begin later in life and that a few of the small ones never do so.

Collections of foraging bees made elsewhere in Mexico during July contained a number of queens of *B. medius*. They were visiting flowers just as do queens of temperate climate bumblebees in the spring. This observation, together with the presence of only a single queen in the large nest excavated, throws doubt on von Ihering's (1903) theory that in a Brazilian bumblebee which is either the same as *medius* or a closely allied species colony multiplication is by swarms. Perhaps the several fecundated queens reported by von Ihering to occur in single nests were mostly young queens which had mated in or temporarily returned to their parental nests.

The colony excavated by us would appear to consist of the progeny of a single queen. It was just renewing activity after a season of reproductive inactivity, probably correlated with the dry season. In spite of its large size, this colony probably had not yet passed through the phase when new queens and males are produced, for no queen cocoons were found in the nest. The disparity in size between the queen and workers and the large number of queens ordinarily produced in *Bombus* nests make it unlikely that queen cocoons were present, but unrecognized.

In Brazil, von Ihering (1903) observed fecundated queens and some males overwintering in the parental nest. Collections of *B. medius* queens visiting flowers in July suggest that the fecundated queens may pass the season of adversity (dry season combined with the cool season) in the same manner in Mexico.

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New Synonymy of an Australian Iridomyrmex (Hymenoptera: Formicidae).—*Iridomyrmex biconvexus* Santschi, 1928, Bull. Soc. Vaud Sci. Nat., 56: 471, worker (Type loc.: Ringwood, Victoria. Syntypes in Naturh. Mus., Basel; Mus. Comp. Zool.) proves to be the senior synonym of *Iridomyrmex foetans* Clark, 1929, Vict. Naturalist, Melbourne, 46: 122, pl. 1, figs. 4, 4a, worker (Type loc.: Cann River, Victoria. Syntypes in Nat. Mus. Vict., Melbourne; Mus. Comp. Zool.) as here noticed for the first time. I have compared syntypes directly, and they are obviously conspecific. The promesonotal suture is mobile, affecting the alitruncal profile. I have found this species abundant in the Dandenongs and Warburton Ranges, Victoria, in medium to wet sclerophyll forest, particularly in those parts dominated by *Eucalyptus regnans*, although its also occurs down to sea level near Melbourne. Clark also found it common on the Otway Peninsula. In wet *E. regnans*-tree-fern gullies of the Warburton Range, this is the dominant ant species up to at least 3,000 feet. In the snow gum-grass areas above this, it is replaced by a similar *Iridomyrmex* identical with types of *I. emeryi* Crawley, but perhaps synonymous with some older species name. All ant names mentioned here are perhaps junior synonyms of older names obscurely attached. — W. L. Brown, Jr., Museum of Comparative Zoology, Harvard University.

THE INDO-AUSTRALIAN SPECIES OF THE ANT GENUS *STRUMIGENYS* FR. SMITH: *S. CHAPMANI* NEW SPECIES[1]

By William L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

This paper is a further contribution in a series which, when complete, will cover the world fauna of the dacetine ant genus *Strumigenys* Fr. Smith. Previous parts, the first three of which include explanations of the abbreviations used for citing measurements and indices, are in Psyche 60: 1-5; 60: 85-89 (1953), and 60: 160-166 (1954); Jour. N.Y. Ent. Soc. 61: 53-59; 61: 101-110 (1953); 61: 189-200 (1954), and in press.

Strumigenys chapmani, new species
(Text-fig. 1)

Holotype worker: TL 2.8, HL 0.76, ML 0.24 (Full exposed L mandibles 0.27 mm., cited because the mandibles tilt dorsad from the general plane of the cephalic dorsum at an angle approaching 30°, so that they appear foreshortened in the view at which HL is measured in the standard way. In fig. 1, the head is shown as slightly tilted forward, so that the head is a bit shorter and the mandibles a bit longer than as seen at standard HL position.) Head width across occipital lobes 0.68 mm. WL 0.70, exposed scape L 0.30-0.31, funiculus L 0.46 mm., greatest perpendicular depth of head (near posterior quarter of length) about 0.30 mm.; index of cephalic depression (head depth/HL × 100) 39-40, CI 89, MI 31-32.

Head shape as in text-figure 1; bottom of posterior excision with a fine, low translucent lamella. Dorsal surface of head just inside of and parallel to the dorsal scrobe (lateral cephalic) border on each side with a shallow sulcus or broad depression. Occipital lobes massive, with convex apical surfaces. Antennal scrobes deep, overhung by strong, lamellar dorsal borders. Eyes situated a little in front of

[1]Published with a grant from the Museum of Comparative Zoology at Harvard College.

the midlength on the dorsal sides of the ventral scrobe borders, fairly well developed, but not visible from direct dorsal view. A feeble vertical groove in front of the eye terminates the preocular lamina on each side, but does not

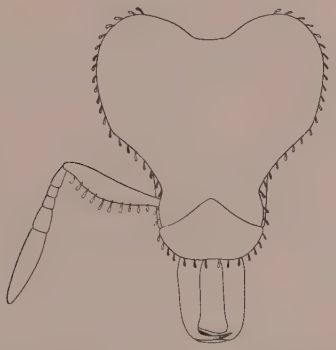

Figure 1. *Strumigenys chapmani* new species, paratype worker, dorsal view of head, showing pilosity of outline only. Teeth on ventral side of mandibular apex omitted. (F. Y. Cheng).

interrupt the rearward extension of the scrobe itself and does not induce any excision or concavity of the dorsal scrobe border directly above.

Ventral surface of head just behind the eyes with a broad, deep, arcuate transverse postoral groove or sulcus; behind this, the ventral surface of the occipital lobes are convex. Preocular laminae subparallel, continuing the lateral clypeal borders posteriad. Clypeus nearly half again as broad as long, broadly subpentagonal, feebly convex over the mandibular insertions and posteromedially; anterior border nearly straight, but strongly impressed in the center.

Mandibles short, stout, depressed, dorsally tilted and very feebly arched as seen from the side, approximately parallel at full closure; inner margins with cultrate translucent borders reaching from near bases to beginning of subapical narrowed portions. Apex of mandible bearing a long, straight, slender dorsal tooth (length 0.11-0.12 mm.) which I interpret as a secondarily migrated preapical tooth that has assumed an apparent apical position. Ven-

tral to this tooth, and even slightly basad, is found what I consider to be the true apical fork, crowded into a new position, consisting of two principal spiniform teeth and two acute, but small, intercalary teeth. The distal (dorsal) of the two larger teeth is 2/3, the proximal about half the length of the large false apical tooth. From direct dorsal view, the true ventral apical tooth appears like a preapical tooth, being situated a bit basad of the false apical tooth, but on the ventral edge of the inner border in contrast to the usual position of preapical teeth in the genus. The ventral tooth is not shown in the figure, although it would normally be at least partly visible in the same view. Altogether, the apical armature reveals its aberrant relationships only on close, critical examination, and the total effect is not strikingly different from that of other species of *Strumigenys*, several of which lack preapical dentition. The basal lamella present as a stout, blunt projection forming a continuation of the inner margin; normally covered entirely by the clypeus at mandibular closure. From ventral view, the basal portion of each mandible is excavated to receive an axehead-shaped lateral lobe of the labrum. Labrum deeply cleft in the middle, the two labral conicles short and subacute, bearing divergent trigger-hairs which curve to follow the mandibles to a little beyond the midlength of the latter. Palpi as usual for the genus.

Antennal scapes very short, exposed length slightly less than the breadth of the head at the level of their insertions and less than half the maximum distance across the occipital lobes, moderately incrassate, with nearly straight posterior border and gently arcuate anterior border. Funiculus stout, the apical segment taking up very slightly more than half its length; segments II and III appearing nearly as broad as long in some views and slightly broader than long in others, together about equalling in length IV; the basal segment very slightly longer, but more slender, than IV.

Alitrunk compact, high in profile, but rather narrow; pronotum less than half as broad as head, disc convex in both directions, narrowly rounded in front and with a low margin here; no humeral angles. Seen from the side, promesonotum forms a high, strongly arched hump, with the

posterior mesonotum sloping through a feeble convexity posteriorly. Metanotal groove obsolete; propodeum extremely feebly convex in dorsal outline, beginning at the foot of the posterior mesonotal slope and itself sloping posteriorly, but much more gently so. Propodeal teeth long (0.10 mm.) and stout, acute, obliquely elevated; infradental lamellae very narrow, concave, widening below into low, convex metapleural lobes.

Petiole with very slender peduncle, longer than the subglobose free portion of the node, which is about as broad as long and has a feeble longitudinal carinula running over each dorsolateral surface. Posterior neck of petiole partly covered by the narrow spongiform collar, which widens a bit on each side to form a broadly rounded posterolateral spongiform lobe. Midventral spongy strip well developed. Postpetiole moderate in size, slightly broader than long and distinctly broader than the petiole, its disc convex and surrounded by spongiform margins; well developed spongiform masses posterolaterally and ventrally. Gaster with ventral surface much more strongly convex than dorsum; anterior spongiform margin narrow dorsally, its edge gently raised and convex in the middle. Basal gastric costulae rather irregular and indefinite, extending about ¼ the length of the basal tergite; gastric surface otherwise smooth and shining.

Head, including scapes and dorsal surfaces of mandibles, dorsum of alitrunk, legs and petiole densely and finely granulose-punctulate, opaque. Much of sides of alitrunk and dorsal surface of postpetiole with punctulation partially effaced, weakly shining to subopaque.

Cephalic dorsum, mandibles, scapes and promesonotum with a regular and dense pilosity consisting of small, numerous, subappressed to subreclinate, spatulate to inverted-spoon-shaped hairs, on the dorsum of the head appearing like small oval scales. Anterior scape border with a regular, prominent row of outstanding narrowly spoon-shaped hairs, prevailingly slightly oblique apicad. Specialized erect pilosity of head and alitrunk lacking, except for a single weakly differentiated suberect spatulate hair on the extremity of each occipital lobe. Propodeum, anterior of petiolar node and legs with a sparse growth of small.

subreclinate spatulate hairs; legs also with a few fine, erect subclavate hairs. Long (up to 0.13 mm.) sturdy erect hairs, distinctly spatulate apically and mostly posteriorly inclined: one pair on petiolar node; 3-4 pairs, some shorter, on postpetiole; about four ragged transverse rows of 4-6 hairs each on the gastric dorsum. Gastric apex with a few fine erect hairs. Underside of head with small, fine appressed hairs.

Color uniform medium ferruginous; legs, mandibles and antennae appearing a little lighter and more yellowish.

Paratype workers: Four specimens from the type nest. TL 2.63-2.85 mm., HL 0.72-0.76 mm., ML 0.22-0.24 mm., WL 0.66-0.71 mm.; CI 89-91, MI 31-32. Outside the minor variation in dimensions and proportions, as cited, the length and proportions of the antennae and antennal segments appear to vary very slightly, and there are some small differences in position, size and direction of hairs. Everything considered, the variation in this series is remarkably slight. Further series of this species, seen belatedly and reviewed more hastily, do not seem to vary much, if any, from the type nest series.

Female not seen.

Male from type nest: TL 2.58 mm., CI about 76, length of forewing about 2.25 mm. Mandibles reduced and inserted far apart, but very strongly incurved, falcate, with very acute, simple, opposable apices, their shafts broadened just beyond the bases and externally bluntly subangulate, somewhat as in the workers of certain *Labidogenys* species.

Notauli very indistinct near point of convergence; parapsidal furrows distinct; anterior mesonotum with a median longitudinal furrow; scutellum convex and salient. Propodeal teeth represented by two low subangular welts. Petiole and postpetiole formed as in worker, but spongiform appendages reduced to cariniform vestiges. Basal gastric costulae absent. Gaster and most of meso- and metapleura smooth and shining; nodes and fore coxae very feebly punctulate and shining; remainder of body densely punctulate, opaque. Head and alitrunk with short, fine appressed hairs, curved and inconspicuous; gaster with a few very small, fine, suberect and reclinate hairs, more abundant at apex.

General body color castaneous, head brownish-black; pronotum dark ferruginous, mesonotum with lighter markings anteriorly and along parapsidal furrows; legs, mandibles and antennae sordid yellow-brown. Forewing with R + Sc, Stigma, 2r, Rsf_1, Mf_1, M + CuA and CuA persisting, but scarcely pigmented. Rs and M indicated apically by long grooves. Hind wing with 4 subapical hamuli. Wings densely microtrichiate. Volsellae not especially distinctive; penis valves each with about 15 serrations. A second male taken in the type nest was smaller, but otherwise similar.

Holotype worker, and worker and male paratypes taken from a single nest, Horns of Negros [Cuernos Mts.] near Dumaguete, Negros Oriental, Philippine Islands, at about 1500 feet altitude (J. W. Chapman). Holotype deposited in the Museum of Comparative Zoology; paratypes in U. S. National Museum, California Academy of Sciences, and elsewhere. Several series of this species, collected by Dr. Chapman and D. Empeso in the Cuernos Mts. at or near the type locality, were examined after the descriptions had been drawn up. Although this additional material slightly extends the range of variation in dimensions and proportions, the total variation away from the holotype is hardly worth recording.

S. chapmani is a species apparently totally different and distinct from any of the known groups of the genus anywhere in the world. Even its affinities with the remainder of the Indo-Papuasian fauna must be considered as more or less arbitrarily drawn. If the interpretation of the apical mandibular dentition given above is correct, a tentative relationship may be suggested with the *loriae* and *szalayi* groups; the form and tilt of the mandibles also suggests that of certain members of the "Labidogenys" complex.

TABANIDAE OF NEW HAMPSHIRE

By R. L. Blickle[1]

University of New Hampshire

Many species of Tabanidae are of economic importance in the state as pests of man and of livestock. In general, the species of the genus *Tabanus* are more important as regards livestock, while those of the genus *Chrysops* are irritating to man. The following horseflies, listed in order of their appearance during the summer, are of economic importance; *Tabanus lasiopthalmus, T. typhus, T. lineola, T. trispilus, T. aurilimbus,* and *T. sulcifrons.* Along the coast *T. nigrovittatus* in mid-summer and *T. actaeon* in late summer have been numerous enough at times to be important. Other species present at the same time as those mentioned above, though not numerous, contribute to the losses attributed to horseflies. The deerflies, although very numerous, do not irritate the cattle or cause as much loss of blood as do the larger horseflies. The deerflies are important as pests of man in recreational areas and in tracts where lumbering operations are being conducted. Those species causing discomfort to man because of their abundance are: *Chrysops mitis, C. sordida, C. carbonaria,* and *C. excitans* in early summer. *C. lateralis, C. striata, C. univittata,* and *C. vittata* are important along the seashore and causes more discomfort to many than any other species of Tabanidae.

The list of species and subspecies is based mainly on material in the University of New Hampshire collection. Incorporated in the collection are the specimens donated by the late S. A. Shaw. Mr. Shaw was an active collector of insects, especially Diptera, from 1890 until 1934. Other collectors contributing to the collection have been: R. L. Blickle, J. G. Conklin, W. F. Fiske, A. G. Humes, P. R. Lowry, W. J. Morse, H. W. Smith and C. M. Weed. Additional records were obtained from the Museum of Com-

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parative Zoology and from the Boston Society collection, now at Boston University. The examination of these collections was made possible through the courtesy of Drs. J. Bequaert and A. G. Humes, respectively.

Published lists recording species taken in New Hampshire are: Johnson (1925, 1925a), Brennan (1935), Stone (1938), Philip (1947, 1950), and Fairchild (1950). In all forty-nine species and subspecies are recorded in the above works. The present list contains seventy-one species and subspecies. Four species recorded from both Maine and Massachusetts are also listed. Judging from the distribution of tabanids in the neighboring states and in Canada, the number recorded will eventually be approximately ninety.

Locality records are given as townships. Only the extreme dates of capture are listed. Most of the records are from the southeastern part of the state and from the White Mountain area. The western part of the state north of the Mt. Monadnock area is poorly represented.

The author is indebted to Dr. L. L. Pechuman for the determination of the flies.

Stonemyia Brennan

rasa (Loew): Durham, Gilmanton, Hampton, Lee, Mt. Washington, New Durham, Pelham, July 19 to Aug. 29.

tranquilla (Osten Sacken): Crawford Notch, Durham, Gilmanton, Hampton, Kearsarge, Lee, New Durham, Mt. Washington, North Conway, Ossipee, Pinkham Notch, Twin Mts., White Mountains (type loc.) July 18 to Aug. 23.

Chrysops Meigen

aberrans Philip: Alton, Durham, Gilmanton, Lee, Madbury, New Durham. June 15 to Sept. 9.

amazon Daecke: Durham, Lee, Rochester. June 15 to July 13,

atlantica Pechuman: Hampton (S. A. Shaw). July 1 to Aug. 21.

callida Osten Sacken: Barrington, Durham, Gilmanton, Hampton, Lee, Milford. June 12 to Aug. 4.

carbonaria Walker: Bretton Woods, Colebrook, Conway,

Durham, Gorham, Hampton, Hanover, Intervale, Lee, Madbury, Merrimack, Ossipee, Pittsburg, Twin Mts. May 7 to July 14.

celer Osten Sacken: Colebrook, Dummer, Durham, Hampton, Lee, Milford, Pittsburg, Rye, June 1 to July 23.

cuclux Whitney: Bretton Woods, Colebrook, Durham, Hampton, Madbury, Milford (type loc.), Moultonboro, Pittsburg, White Mts., May 10 to July 14.

cursim Whitney: Milford (type loc.). July.

delicatula Osten Sacken: Alton, Durham, Gilmanton, Lee, Madbury, Madison, New Durham, North Conway (type loc.), Webster. July 12 to Aug. 14.

dimmocki Hine: Lee (R. L. Blickle). July 8.

excitans Walker: Antrim, Belmont, Bretton Woods, Colebrook, Dixville, Durham, Dummer, Gorham, Lee, Madbury, Newfields, North Conway, Ossipee, Pittsburg, Rye, Tamworth. June 3 to July 12.

frigida Osten Sacken: Durham, Lee, Milford, New Durham, North Conway, White Mts. June 11 to July 14.

frigida xantha Philip: Milford, Franconia. July 8.

fuliginosa Wiedemann: Durham, Hampton, Lee. June 6 to July 2.

geminata Wiedemann: Belknap, Belmont, Durham, Greenfield, Hill, Lee, Lyme, Madbury, Milford, New Durham, Wilton. July 5 to July 25.

geminata impunctata Krober: Durham (R. L. Blickle). July 18.

inda Osten Sacken: Milford, Pittsburg. June 20 to July 1.

lateralis Wiedemann: Barrington, Belmont, Bretton Woods, Dublin, Durham, Gilford, Gilmanton, Hampton, Hanover, Intervale, Lee, Jaffrey, Madbury, Milford, Mt. Monadnock, New Durham, North Conway, Portsmouth, Rochester, Squam Lake, Mt. Washington, Woodstock. June 11 to Aug. 24.

mitis Osten Sacken: Bretton Woods, Dixville, Franconia, Jaffrey, Mt. Washington, Pittsburg. June 11 to July 7.

moecha Osten Sacken: Alton, Durham, Hampton, Lee, Madbury. June 1 to Aug. 24.

montana Osten Sacken: Alton, Durham, Lee. July 6 to July 18.

nigra Macquart: Alton, Belmont, Dixville, Durham,

Hampton, Madbury, Milford, Mt. Washington, Newfields, Pittsburg, Rochester. June 1 to Aug. 11.

nigribimbo Whitney: Milford (type loc.). July 9 to July 21.

pudica Osten Sacken: Durham, Lee (R. L. Blickle). July 4.

sackeni Hine: Durham, Hampton, Lee, Milford, Newfields. June 17 to Aug. 8.

shermani Hine: Berlin, Dixville (R. L. Blickle). June 19 to June 20.

sordida Osten Sacken: Bretton Woods, Colebrook, Dixville, Dummer, Franconia, Mt. Washington, Pittsburg, Twin Mts. (type loc.). June 19 to July 16.

striata Osten Sacken: Belmont, Durham, Gilmanton, Hampton, Lee, Madbury, New Durham, Sanbornton. June 22 to July 30.

univittata Macquart: Belmont, Durham, Gilmanton, Hampton, Lee, Madbury, Milford, New Durham, Newfields, Ossipee. May 21 to Sept. 11.

vittata Wiedemann: Belmont, Durham, Gilmanton, Greenfield, Hampton, Lee, Madbury, Milford, New Durham, Pelham, Rye, Sanbornton. June 19 to Sept. 9.

wiedemanni Krober: Alton, Durham, Epping, Hampton, Lee, Madbury, Milford, New Durham. June 12 to Sept. 9.

Atylotus Osten Sacken

bicolor (Wiedemann): Hampton, Webster. July 15 to Aug. 5.

pemeticus (Johnson): Recorded from Maine and Massachusetts (Philip 1947).

thoracicus (Hine): Recorded from Maine and Massachusetts (Philip 1947).

Tabanus L. (*Hybomitra* Enderlein)

affinis Kirby: Bretton Woods, Intervale, Jaffrey, Mt. Monadnock, New Durham, Peterboro, Shelburne, Mt. Washington. June 21 to July 11.

aurilimbus Stone: Belmont, Durham, Gilmanton, Hampton, Epping, Madbury, Milford, New Durham, North Hampton. June 29 to Aug. 5.

astutus Osten Sacken: Pinkham Notch, White Mts. (type loc.). Aug. 21-22.

brennani Stone: Franconia (type loc.). July 14.

cinctus Fabricius: Dublin, Durham, Lee, Madbury, Union. July 23 to Aug. 2.

epistates Osten Sacken: Durham, Lee, Mt. Monadnock, Shelburne. July 4 to July 25.

hinei Johnson: Lee, Madbury (R. L. Blickle). June 28 to July 25.

illotus Osten Sacken: Pittsburg (Morse, Blickle). June 20.

lasiopthalmus Macquart: Bretton Woods, Dummer, Durham, Hampton, Hanover, Jackson, Jefferson, Lee, Newfields, Pelham, Pittsburg, Rye, Twin Mts. May 30 to Aug. 15.

longiglossus Philip: Recorded from Maine and Massachusetts (Philip 1947).

metabolus McDunnough: Hampton, Jaffrey, Milford, Passaconaway, Pittsburg.

microcephalus Osten Sacken: Lee, Jackson, Madbury, New Durham, Pinkham Notch, Rumney, Twin Mts., White Mts. (type loc.). July 8 to Sept. 9.

minusculus Hine: Philip (1950).

nudus McDunnough: Durham, Hampton, Jackson, Jaffrey, Lee, New Durham, Passaconaway, Pittsburg. May 3 to June 20.

septentrionalis Loew: Recorded from Maine and Massachusetts (Philip 1947).

trepidus McDunnough: Colebrook, Dummer, Durham, Hampton, Lee. June 10 to Aug. 10.

trispilus Wiedemann: Barrington, Dublin, Durham, Epping, Franconia, Hampton, Lee, Madbury, Newfields, Pittsfield. July 4 to Aug. 8.

typhus Whitney: Barrington, Durham, Freedom, Lee, Madbury, Milford (type loc.), New Durham, North Conway. June 15 to July 27.

zonalis Kirby: Lee, Milford, Passaconaway. June 8 to July 15.

Tabanus L. (*Tabanus* s.str.)

actaeon Osten Sacken: Amherst, Dublin, Durham, Hampton, Lee, Milford, Pelham, Rye. Aug. 9 to Sept. 17.

americanus Forster: Dublin. (Johnson 1925 a). July.

atratus Fabricius: Durham, Hampton, Lee, Pelham. June 30 to Aug. 28.

atratus fulvopilosus Johnson: Durham (H. W. Smith). July 22.

atratus nantuckensis Hine: Hampton, Newfields, Rochester. July 9 to Sept. 13.

catenatus Walker: Durham, Hampton, Jaffrey, Lee, Rye. July 7 to Aug. 27.

fairchildi Stone: Alstead, Hillsboro. July 1 to July 16.

lineola Fabricius: Barrington, Durham, Gilmanton, Hampton, Lee, Madbury.

lineola scutellaris Walker: Durham, Hampton, Lee. June 17 to July 20.

nigripes Wiedemann: Hampton, Milford. July 3 to July 14.

nigrovittatus Macquart: Durham, Hampton, Newmarket, Portsmouth, Rye. June 30 to Aug. 8.

nivosus Osten Sacken: Durham, Freedom, Hampton, Lee, New Durham. June 12 to July 31.

pumilus Macquart: Barrington, Durham, Lee, Madbury, Portsmouth. July 1 to July 31.

quinquevittatus Wiedemann: Durham, Gilmanton, Lee, Madbury, New Durham, Newfields, Newmarket. July 2 to Sept. 21.

reinwardtii Wiedemann: Durham, Newfields. July 11 to Aug. 1.

sparus Whitney: Durham, Hampton, Lee, Milford (type loc.), Newfields, Rye. June 10 to July 20.

stygius Say: Durham. (no date).

sulcifrons Macquart: Durham, Hampton, Lee, Madbury. July 11 to Sept. 9.

superjumentarius Whitney: Durham, Epping, Hampton, Lee, Madbury, Milford (type loc.). June 14 to Aug. 3.

vivax Osten Sacken: Durham, Farmington, Gilmanton, Hampton, Lee, Strafford. July 4 to July 23.

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